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“Public and Private Risk Management
in a Carbon-Constrained Energy Sector”

The energy sector contains many types of risks and thus requires a sophisticated approach to decision-making in both the public and private spheres. In terms of public (or social) risks, the energy sector presents strategic risks (especially in oil) and environmental risks. The former has often traditionally been managed through physical hedging (such as with the Strategic Petroleum Reserve) and political negotiations. The latter is typically managed by government regulation.

Private risks include price volatility, the financial risk of potentially large capital investments, and the risk of future environmental regulation. The first of this set is managed with long-term contracts or through futures and other derivatives, depending on which commodity is being considered. The second is managed through long term contracts, by cost-of-service regulation, government loan guarantees, and sometimes through real options. The third is typically managed through political negotiations, government protection from liability, and careful investment choices.

One of the biggest challenges for the energy sector is the transformation that will be required over the next several decades as constraints on carbon dioxide (CO₂) are imposed and then tightened, due to concerns about global climate change. Many technologies that could help enable this transition have relatively high capital costs and are considered risky investments, such as nuclear power or advanced biomass (e.g. cellulosic ethanol). More importantly, the value of many of these technologies is greatly reduced, or eliminated, in the absence of carbon restrictions. Thus, there emerges a tension between innovation and investments that might help mitigate climate change risks on one hand but bring financial risks on the other. In this project, we propose to use quantitative tools from financial risk management to analyze these risks and develop strategies to manage the risk.

In our proposal, we will examine two industries that will dominate climate change policy: the electricity and petroleum sectors. The two industries share similar challenges, yet also feature important differences with interesting implications for the evaluation of physical options. An important difference between these sectors is the makeup and geographic scope of their respective markets. The petroleum industry operates in a global market strongly influenced by national (i.e. state-controlled) oil companies and an oligopolistic cartel (OPEC), while electricity markets are much more localized and dominated by private firms. One consequence of this difference is the endogeneity of investment choices on market prices. Individual investments are unlikely to impact oil prices, while they can have major impacts on prices in a given local electricity market. Thus in the oil markets, it is reasonable to represent price paths as exogenous stochastic processes, as is usually the case using traditional financial models of risk management. In many electricity markets, it can be dangerously simplistic to assume that prices are not impacted by specific decisions, and therefore more detailed structural models are necessary.

We will focus first on private risks in a carbon-constrained electricity sector, for which an appropriate analytical framework can be readily identified. Later, we will focus on private risks in a carbon-constrained petroleum sector, for which the appropriate approach must be identified. Finally, public risks associated with imposing climate change policy on these two sectors will be considered.